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Review and synthesis of sustainable community indicators used in monitoring forest community sustainability

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REVIEW AND SYNTHESIS OF SUSTAINABLE COMMUNITY INDICATORS USED IN MONITORING FOREST COMMUNITY SUSTAINABILITY

by

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A CAUTION TO THE READER

This MF project has been through a semi-formal process of review and comment by at least two faculty members. It is made available for loan by the Faculty of Forestry and the Forest Environment for the purpose of advancing the practice of professional and scientific forestry.

The reader should be aware that opinions and conclusions expressed in this document are those of the student and do not necessarily reflect the opinions of either the Project supervisor, the faculty or Lakehead University.

ABSTRACT

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Key Words: communities, effective, frameworks, indicators, linkage, sustainability.

The objectives of this project are: (1) to review literature related to sustainable community indicators that will include studies on: social indicators, sustainable forest management indicators, and sustainable community indicators; (2) to develop a viable framework for measuring sustainability of communities; and (3) to develop a list of sustainable community categories and indicators.

To better understand the effectiveness of sustainable community indicators in measuring forest community sustainability, the review of literature is divided into two parts. The first part covers frameworks that are used by different scientists in the development of sustainable community indicators. The second part covers three studies undertaken in the Canadian Model Forest Program (CMFP) to assess forest community sustainability. The first study is based on social indicators, the second study is based on sustainable forest management indicators, and the third study is based on sustainable community indicators. The main reason for selecting all three studies from the CMFP is that only in the CMFP research is being carried out on community sustainability at the local level by adopting different approaches (indicated above). The results of the studies in the literature review are compared to the results of the study in this project to determine the effectiveness of the indicators developed in this study. The indicators developed in this study focus on sector (population, employment, education, poverty and forest operations) sustainability as well as across the sector sustainability. Sector sustainability is achieved by assessing the present status of the categories. Across the sector sustainability is assessed by taking into account the impact of each sector on the environment, society and economy (ESE). Based on the results of this study, it can be said that every sustainable community indicator is a social indicator, but every social indicator is not a sustainable community indicator. To achieve sustainable development, it is important to treat the ESE as an integrated unit, and not isolated parts.

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INTRODUCTION

The traditional social indicators are statistically based and focus on population and migration, employment, income distribution, and per capita income, to measure sustainability at the community level (Beckley and Burkosky, 1999; Hart, 1999; Parkins and Beckley, 2001). These statistical numbers inform us only about changes in one part of the community. For example, an increase in the employment rate by four percent does not inform us about any potential impact of the increase in employment on environment and society (Hart, 1995).

Many scientists have developed sustainable community indicators by adopting different frameworks (Hart, 1995; Beckley, 1999; Griffin, 2001; Parkins and Beckley, 2001; Ditor *et al.*, 2001). The emphasis of their frameworks is on sector sustainability: social sustainability, economic sustainability, forest sustainability, population sustainability and environmental sustainability. The frameworks, however, fail to address the issue of sustainability across the sectors, by not identifying indicators that link all the sectors. Sector sustainability will never result in sustainable development because an essential component of sustainability, that is, linkage between the environment, society and economy (ESE) is ignored.

To measure community sustainability, the need is to develop a viable framework with local community participation that links the ESE (Ruitenbeek, 1991; Bregha *et al.*, 1993; Hart, 1999; Beckley, 1999; Parkins, 1999; Ditor *et al.*, 2001).

The objectives of this project are as follows:

(1) To review literature related to sustainable community indicators that will include studies on: social indicators, sustainable forest management indicators, and sustainable community indicators;

(2) To develop a viable framework for measuring sustainability of communities; and

(3) To develop a list of sustainable community categories and indicators.

The technical definitions of the different terms used in this report are presented in Appendix I. The purpose of giving the definitions is to familiarize the reader with the technical terms used throughout the report.

LITERATURE REVIEW

The review of literature relating to sustainable community indicators is divided into two parts. The first part covers frameworks, which are recommended by scientists such as Hart (1995) and Maclaren (1996), to develop sustainable community indicators for the measurement of community sustainability. The second part covers three studies undertaken in the Canadian Model Forest Program (CMFP), to assess the sustainability of forest communities by employing different approaches.

PART 1: FRAMEWORKS FOR SELECTING SUSTAINABLE COMMUNITY INDICATORS

The monitoring of forest community sustainability is a relatively new field. Sustainability or sustainable development received the impetus in 1987, when the Brundtland Commission Report, Our Common Future, called for sustainable development; "The development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (UNCED, 1987). Since then, various efforts have been undertaken by social scientists to develop frameworks, to measure sustainability at the local, regional, national and international levels.

Various frameworks for the development of sustainable community indicators (to measure sustainable development), are suggested by social scientists (Hart, 1995; Maclaren, 1996; Hardi and Zdan, 1997). Most of the frameworks discussed below provide an insight into understanding the term "sustainable community indicators" by stressing the importance of establishing a link across the three components of the community (ESE).

The initial driving force to study the sustainability of forest communities was provided by Kaufman and Kaufman (1946), when they undertook research to study the stability of timber dependent communities in Montana (USA). The recommendation of the study emphasized that a number of variables must be considered in studying community sustainability. The recommended variables are economic diversity, community leadership, public participation, and sustained forest yield. The incorporation of public participation in monitoring forest community sustainability was a novel idea at that time (Beckley *et al.*, 2002).

The Kaufman and Kaufman (1946) recommendations, with additions, were addressed by Hart (1995), in "Guide to Sustainable Community Indicators". The guide asserts that a sustainable community should develop, maintain and enhance sustainability within the sectors such as health, population, transportation, environment, and also across these sectors. Across the sectors sustainability must be achieved by assessing impact of each sector on the ESE. The framework designed by Hart (1995), to develop sustainable community indicators is comprised of the following principles:

- Indicator relevance to sustainability;
- Understandable to the community at large;
- Developed and accepted by the community;
- Focuses on a long term view of the community sustainability (20-50 years);
- A link between different components of community that is economy, environment and society;
- A measure of local sustainability that is not at the expense of global sustainability;
- Based on reliable, easily available information; and
- Information available on a regular basis.

The indicators that satisfy all the above mentioned principles will be good community sustainability indicators. Hart (1995) organized these principles into a ordinal number scale (1-9) of bad, moderate, and good indicators. Bad indicators were those which

scored low on the scale (<3). Good indicators scored high on the scale (>7), and moderate indicators scored in the middle (4-6). With this scale more than 100 indicators compiled from other reports were ranked under categories such as education, economy, environment, population and housing. More than 90% of the reviewed indicators scored low on the scale (poor indicators). The ranking made it clear that a single indicator in a category cannot satisfy all the above mentioned principles. The need is for development of a framework that takes into account all the principles produced by Hart (1995).

The importance of a suitable framework selection for the development of sustainable community indicators was also highlighted by Maclaren (1996). In her study entitled "Indicator Frameworks" she outlined six major frameworks for the development of sustainable community indicators to measure sustainability at the community level. The frameworks suggested by Maclaren (1996) are discussed below.

The domain-based framework

The focus of the domain-based framework is on the three main components of community that are ESE. Two types of indicators are developed in this framework to measure community sustainability. One type of indicators presents the sector sustainability, and the second type establishes a link between the three components of community.

The domain-based framework emphasizes on both; the sector as well as across the sector sustainability of the forest communities. The indicators developed in this framework are organized under the categories such as wildlife habitat, air quality, energy and solid waste. No viable linkage between the sectors is established through indicators in the framework. Therefore, the main objective of community sustainability is not achieved.

The conclusion drawn from the application of this framework to develop sustainable community indicators is that great caution is to be observed in developing indicators to ensure sector as well as across the sector sustainability.

The issue-based framework

This framework mainly focuses on prioritizing issues under specific themes (e.g., environmental theme). This framework is used by the Canadian National Environmental Indicators Series (CNEIS). In CNEIS the environmental issues are grouped under four themes: ecological life support systems, natural resources sustainability, human health and well being, and pervasive influencing factors. The issues identified under the ecological life support systems are: acid rain, biodiversity change, climate change, forest ecosystems, marine ecosystems, ozone depletion and air pollution. The issues identified under natural resources sustainability are: agriculture resources, and sustaining forest and marine resources. The issues identified under human health and well being are fresh water quality, air quality, freshwater use and waste water treatment. The issues identified under pervasive influencing factors are: transportation, energy consumption, population growth and lifestyle patterns. Finally, for each issue, potential indicators of stress, condition and society response are developed.

This framework is effective and adaptive, because it takes into account the status of the issues and suggests measures for its recuperation and also accommodates new indicators to assess community sustainability when needed.

The major disadvantage of this framework is that the emphasis is on sector sustainability, because the issues are grouped under sectors and the societal response is also focused on sectors. This framework does not take into account across the sectors sustainability. For example, the indicators developed under the energy sector only focus on

the energy sector (energy consumption per household), and do not show the impact of energy consumption on natural resources. To achieve across the sector sustainability, it is important that some of the indicators developed under the sectors must exhibit a relationship across the sectors.

The goal-based framework

In this framework, the community vision of sustainability is the main component in the development of sustainable community indicators. The community vision of sustainability may focus on the ESE. The indicators selected under each category (community vision) will monitor the status of that category.

If the goal of community is to achieve sector sustainability, the indicators developed will address the issues under each sector such as population and energy. If the goal of community is to achieve sustainable development at the community level, indicators developed will focus on sector, as well as across the sector sustainability. Therefore, it is stressed that when such a framework is employed to develop sustainable community indicators, its focus must be on sector as well as across the sectors sustainability.

The causal-based framework

This framework organizes the sustainable community indicators into the categories of stress, condition and responses in each sector such as environment. The stress indicators suggest the cause of degradation in environment. The condition indicators suggest the status of the damage done to the environment. The response indicators provide an insight to the community actions taken to rectify the situation.

The framework in its present form only ensures sector sustainability, and not across the sector sustainability since it does not take into account the impact of environment improvement on the economy and community. This framework can be used to develop indicators which will establish an active relationship across the sectors of sustainability (ESE).

The sector-based framework

This framework organizes the indicators into sectors such as transportation, health, education, recreation and housing. The advantage of this framework is that the sector sustainability is assessed effectively by basing the entire planning on sectors. The major disadvantage of this framework is that there is lack of linkage developed across the sectors; it will not ensure across the sectors sustainability.

Sector-based frameworks are not recommended to assess community sustainability because community sustainability is about achieving a balance in the components of the community (ESE). This balance can only be achieved by establishing a link across the sectors.

The Community Oriented Model of the Lived Environment (COMLE) model

This model is a combination of the above mentioned frameworks. Strengths of the frameworks discussed above are incorporated into this framework. In this framework indicators are developed for variables such as transportation and housing and are linked to environment integrity, social well-being and economic vitality to assess the impact of variables on society. For example, the indicators developed under the component of economic vitality (transportation) are availability of transportation and employment. Indicators developed under the component of social well-being (transportation) are

availability, equity and safety. Finally, the indicators developed for the component of environmental integrity (transportation) are energy resource consumption and pollution (Maclaren, 1996).

The COMLE model is a good model in displaying sector sustainability, but has failed to develop a link across the sectors by not taking into account the impact of the components on the ESE and community resilience. For example, indicators developed for the component of social well-being (transportation) do not take into account the impact of social well-being on the ESE.

The frameworks discussed above for developing community sustainability indicators are very informative, and provide a good foundation for the development of a framework that can be used to exhibit community sustainability.

The Bellagio Principles of Sustainability

At the international level efforts were also underway to develop a framework for the measurement of sustainable development. In 1996, in Bellagio, Italy a conference was held to devise ways to measure sustainable development at the local, regional, national and international levels (Hardi and Zdan, 1997). The participants consisted of international practitioners and researchers on sustainable development. The group produced 10 principles to measure sustainable development at the local, regional, national and international levels. The principles are as follows.

Guiding vision and goals

The focus is on a clear vision and goals of sustainable development. First, sustainable development should be defined, and then methods of measuring sustainable development must clearly be outlined.

Holistic perspective

As the name suggests, it is a review of the whole system (ESE), and its components at the local, regional, national and international levels to measure sustainable development.

Essential elements

The essential elements should include: equity within the current population and between present and future generations, biodiversity, economy and population. More variables deemed suitable by the community in the measurement of sustainable development can be added to the framework.

Adequate scope

The measurement of sustainable development should be a continuous process covering extensive areas (to be undertaken by all the governments around the world).

Practical focus

The practical focus includes: selection of a limited number of indicators or combination of indicators which provide a clear signal of progress, standardization of measurements to allow comparison and linkage of indicators across the sectors.

Openness

Information generated in this process should be shared with all the communities, governments, non-government organizations (NGOs) and all others interested in the information.

Effective communication

The structure to measure sustainable development should be simple; easily understandable by the audience and the users.

Broad participation

Broad participation means participation by all stakeholders; no one should be left out. This is very essential, because if a legitimate partner is left out of the process, he can be a cause of a major problem. He will never let the process of sustainable development in an area go forward. It is also not fair to leave a legitimate partner out of the loop.

Ongoing assessment

The format to study sustainable development should be flexible, adaptive and responsive to change. This principle is also emphasized by Rempel *et al.* (2004) in the development of indicators to measure the sustainability of forest communities.

Institutional capacity

It will include: development of local assessment capacity regarding measurement of sustainable development, assigning responsibilities to the stakeholders and the stakeholders provide on going support to the decision making process.

The framework discussed above is a very comprehensive framework, as it has touched on all details required to monitor and measure a sustainable community (sustainable development). The question arises, how all of the 10 principles could be made a part of a format meant to measure the sustainability of communities. The answer lies in a process that is called Participatory Rural Appraisal (PRA) techniques. In PRA, facilitators interact with the stakeholders in formal learning and experience sharing workshops. In the

workshops, the stakeholders are informed of the PRA process. Once the stakeholders become familiar with the PRA process, they develop their own plan for the measurement of sustainable development. A formal plan of action is laid out with responsibilities fixed. As a result of fixing responsibilities, all stakeholders are well aware of their roles in planning, monitoring, execution and evaluation of the interventions (to bring sustainability).

The Exclusive Frameworks for Forest Communities

The exclusive frameworks to assess sustainability of forest communities were developed by Nadeau *et al.* (1999) in a study entitled "Forest communities: New frameworks for assessing sustainability". The frameworks discussed in the paper are as follows.

Community Capacity

The community capacity framework focuses on the ability of a community to respond positively to social change and to other threats (environmental, social and economical). The community capacity regarding positive response to changes will be determined by its attributes. The four community attributes identified in the report are physical and financial infrastructure, social capital, civic responsiveness and environmental capital. The community attributes that facilitate or impede the community's ability to respond to change are investigated in community capacity.

This framework is based on prevention and solution of problems. This type of framework will be used by a very competent and highly educated community. The community capacity to deal with changes in a positive manner is determined by the community attributes. If the attributes of the community are poor, then the reaction of the community to unhealthy change will be negligible.

Community Well-being

Frameworks based on community well-being have recently been used in forest communities to assess their sustainability. For example, in Alabama's forest communities, the variables used to study the community well-being are: social structures in the area, poverty, educational level, housing tenure, community capacity and employment. Some scientists, such as Overdevest and Green (1995) have used economic development as the main variable to measure community well-being. Other scientists, such as Kusel and Fortmann (1991) have recommended variables pertinent to social, economic and environmental sectors to assess community well-being.

In British Columbia, well-being assessment is being used in the central and northern coastal communities to assess community sustainability. Indicators are developed for the categories of eco-system and human well-being (Mackendrick and Parkins, 2004).

The framework of community well-being used to assess the sustainability of forest communities may not bring sustainability to the community. Sustainability is a very broad concept it involves everything (ESE) within the community, and is not confined only to community well-being. If the core objective of sustainability is to achieve community well-being, it will not bring sustainability to community, because progress in one sector might be achieved at the expense of depletion of another sector.

Community resilience

This framework focuses on the ability (community capacity) of the community to adapt to change. Based on this framework, most resilient communities have a clear picture of the present community trends in the social, economic and environmental sectors, and they also have a future plan to tackle the situation. This framework of community resilience was introduced in the 1990s by the "Upper Columbia Basins Ecosystem Management Project".

As a part of this project, a resilience index was developed by 198 communities, to monitor community sustainability. The resilience index includes the following six principles:

- Aesthetic attractiveness;
- Proximity of outdoor amenities;
- Level of civic involvement;
- Effectiveness of community leaders;
- Economic diversity; and
- Social cohesion among residents.

The framework of community resilience (to develop sustainable community indicators) will be used by very active and well informed (knowledge of law, natural resources and sustainable development) communities. Such communities are eager to achieve sustainable development in their area.

The Sustainable Calgary Society (SCS)

In Calgary, in 1996, a group of local activists formed Sustainable Calgary Society (SCS). The SCS provided a platform for the local residents, to share their thoughts about sustainable development, and to encourage community level solutions to their problems (Keough, 2002).

In addition to promoting local participation in the decision making process, the SCS also developed sustainable community indicators to measure sustainability in their area. The criteria used by the SCS, to develop sustainable community indicators are given below:

- Linkage of indicator to economic, social and ecological factors;
- Understandability and reliability of indicators;
- Responsiveness of indicators;
- Accuracy of indicators;
- Cost effectiveness of indicators; and
- Comparability of indicators.

In the above mentioned principles, a very important principle of community resilience is neglected. It is also very hard to develop indicators that link the ESE.

The SCS produced 36 indicators under the categories: community indicators, natural environment indicators, economy indicators, education indicators, wellness indicators and resource use indicators. The indicators only emphasize sector sustainability and across the sector sustainability is not taken into account, although this was the very first objective in the indicators development program of the SCS. For example, the indicators developed under income equity are: gap between rich and poor, and unemployment rate. The two developed indicators inform only about the present status of the indicators, but fail to inform about any action that is taken to reverse the indicators to a more stable position. Therefore, the developed indicators are not sustainable community indicators.

The Synthesis Approach

Mackendrick and Parkins (2004) have proposed a "Synthesis Approach" after reviewing literature on frameworks used for developing sustainable community indicators in British Columbia. In the synthesis approach, indicators are developed under the categories of community capital and community capacity. The variables developed under community capital are: natural capital, economic capital, social capital and human capital. The indicators developed under each variable of community capital focus on sector sustainability. For example, under the variable of human capital, the indicators developed are: education, professional training, demographic information, student enrollment, health, access to health care, access to household services and access to state services. Such a framework will not be able to achieve the objective of community sustainability, as none of the indicators under the variable of human capital examine the impact of education on

natural, social and economic capital. The variables developed under community capacity are: ecological integrity, economic vitality, civic vitality and physical and mental health. The indicators developed under the variables of community capacity also fail to exhibit the linkage across the sectors of ESE. For example, the indicators developed under the variable of civic vitality are: associational behaviour, civic participation and political participation. The indicators do not take into account the impact of civic participation on ESE.

Summary

At the end of discussion on frameworks, it is concluded that frameworks for indicators development discussed above, fail to ensure across the sectors sustainability (ESE). Such frameworks cannot be used to assess community sustainability, because the main objective of bringing across the sectors sustainability is ignored. To achieve community sustainability the three main components of sustainability (ESE) need to be considered in the development of indicators. First, sector sustainability must be addressed by developing indicators which target the status of variability. Second, across the sectors sustainability can be achieved by developing indicators within each sector which will assess the impact of the variable on ESE. Finally, community resilience must be assessed and promoted to achieve a sustainable community.

PART II: REVIEW OF STUDIES UNDERTAKEN IN (CMFP) TO ASSESS COMMUNITY SUSTAINABILITY BY ADOPTING THREE DIFFERENT APPROACHES

To better understand the effectiveness of sustainable community indicators in measuring forest community sustainability, this part of the literature review is divided into three sections. The first section covers a study based on the social indicators approach to measure forest community sustainability. The second section includes a study undertaken to measure forest community sustainability by employing sustainable forest management indicators. The third section is based on a study undertaken to measure forest community sustainability by using sustainable community indicators. The importance of reviewing studies under each section is: first, to highlight the strengths, and weaknesses of the approaches undertaken to study community sustainability; and second, it will provide food for thought for the development of a framework that will truly address the inadequacy in the measurement of community sustainability. The reason to limit the number of studies under each section to one study is that the same indicators are used on other studies under the same approach to assess community sustainability. For example, the social indicators used by Parkins and Beckley (2001) in the Foothills Model Forest (FMF) are also used by Otter and Beckley (2002) in the Western Newfoundland Model Forest (WNMF) to assess community sustainability.

In this study under each section (social indicators approach, sustainable forest management indicators approach and sustainable community indicators approach), the study reviewed is taken from the Canadian Model Forest Program (CMFP). The main reason for this is that only in the CMFP research is being carried out to study community sustainability at the local level by adopting the different approaches as mentioned above.

Section I: Social Indicators Approach

Brooks (1971) underscored that the interest in social indicators development started in 1890 in the United States of America (USA), when social scientists supported by the then government, took the initiative to develop social indicators to assess social conditions in the USA.

The work on social indicators development received a boost in 1920, when William Ogburn, and his co-researchers developed the theory of "social change" and its measurement at the University of Chicago (USA). Ogburn was appointed as director of research on President Hoover's (USA) Research Committee on Social Trends. This committee in 1933 issued a report entitled "Recent Social Trends in the United States", which was a major step towards trend analysis, that further energized the process of social indicators development (Brooks, 1971; Rossi and Gilmartin, 1980).

A step toward integration of social and economic indicators was taken in 1966, when President Johnson of the USA directed the Department of Health, Education and Welfare, to develop social indicators that would supplement the economic indicators developed by the Bureau of Labor Statistics and the Council of Economic Advisers (Fox, 1974). This development gave birth to socio-economic indicators, such as per-capita income, education and employment. The socio-economic indicators are also used in forest communities around the world to assess their social conditions. If unemployment rate is low, and per-capita income is more in a community, then that community is labeled as a sustainable community.

On the Canadian scene, use of social indicators (to assess social conditions) started in 1871, when the regular census of the Canadian population was initiated. The realization

of the importance of establishing a linkage between the human population and the ecosystem is a recent phenomenon (Parkins and Beckley, 2001).

In the CMFP, the social indicators are employed to assess the status of forest community sustainability. The social indicators employed are population and migration, employment, human capital, income distribution, poverty and real estate (Parkins and Beckley, 2001; Otter and Beckley, 2002).

Study Undertaken to Monitor the Forest Community Sustainability by using the Social Indicators Approach

Parkins and Beckley (2001) studied forest community sustainability in the FMF by employing social indicators (Table 1). The study is entitled "Monitoring Community Sustainability in the Foothills Model Forest: A Social Indicators Approach". This is an expert driven approach in which the social indicators were selected only by experts to measure forest community sustainability in the FMF.

The geographical boundaries of the FMF include Hinton, Yellowhead Municipal District (# 94), Jasper and Foothills. The FMF is located in west central Alberta and covers an area of approximately 2.75 million hectares. The FMF is one of the 11 Model Forests across Canada and is funded and administered by Natural Resources Canada (NRC) and Canadian Forest Service (CFS). The other program partners are Weldwood Inc. of Canada, Alberta Department of Sustainable Resources Development, and Jasper National Park.

The indicators selected and used by Parkins and Beckley (2001), to assess community sustainability in the FMF are discussed below.

Table 1: Presents the criteria, categories and the social indicators used in monitoring forest community sustainability in the FMF (Parkins and Beckley, 2001).

Criteria	Categories	Indicators
Objective Indicators	Population and Migration	• Population • Age distribution by gender • Migration • Percentage change in migration
	Employment	• Unemployment rate • Change in female unemployment rate • Female participation in labor force • Male labor force activity • Male labor force participation • Participation in selected occupation by gender
	Human Capital	• Change in full time school attendance • Change in educational attainment • Highest level of education
	Income Distribution	• Income gap • Income distribution • Household income
	Poverty	• Measures of poverty • Incidence of low income by family and individual • Persons in low income family units
	Real Estate	• Average value of a dwelling • Average gross rent • Owner's major payments on housing • Household payments as a proportion of median income • Percent of owned and rented dwellings • Percent change in owned dwellings
Subjective Indicators	Community Perspectives on population and migration	• Community Perspectives on population and migration
	Jobs for the taking	• Jobs for the taking
	Service sector employment expansion	• Service sector employment expansion
	Seasons of employment	• Seasons of employment
	Middle class employment	• Middle class employment
	Income and community cohesion	• Income and community cohesion

Population and Migration.

This category was selected by Parkins and Beckley (2001) to assess the population change, age distribution by sex, and migration pattern indicators in the project area (FMF). The indicators used to study population and migration are profile indicators, because the indicators have only informed the reader about the population and migration patterns in the FMF (see Table 1). The indicators have served their limited purpose (community profile), but failed to serve the purpose of community sustainability by not taking into account the impact of population and migration on the ESE. The indicators are also not selected by the community, where as in a sustainable community, the indicators must be selected by the community. Therefore all the mentioned conditions make the selected indicators (to assess community sustainability) poor community sustainability indicators.

To create sustainable community indicators for the category of population and migration, the emphasis will be on treating the category (population and migration) as a part of the community. First, the current status of the category must be studied, and then the impact of the category (population and migration) on the ESE will be evaluated with indicators (Table 2).

Table 2: Categories and indicators used in monitoring forest community sustainability in the FMF, and additional indicators of forest community sustainability.

Categories	Indicators	Additional indicators of forest community sustainability
Population and Migration	• Population • Age distribution by gender • Migration • Percentage change in migration	• Impact of population increase on natural resources, education, distribution of population, sewage production, community cohesion, economy diversification, crime rate in the area, skills development and steps taken by the community to combat pollution and other problems. • Implementation level of community decisions.
Employment	• Unemployment rate • Change in female unemployment rate • Female participation in labor force • Male labor force activity • Male labor force participation • Participation in selected occupation by gender	• Impact of employment on education, community cohesion, community leisure time, community earnings spent locally, garbage creation, measures taken by the community to reduce waste creation, local businesses, natural resources and availability of jobs with respect to education.
Human Capital	• Change in full time school attendance • Change in educational attainment • Highest level of education	• Impact of human capital on technical institutions in the area, availability of jobs with respect to education, local skills development, out and in migration, natural resources, quality of life, community cohesion, efforts towards creating an eco-friendly society and on the economic diversification in the area.
Income Distribution	• Income gap • Income distribution • Household income	• Impact of income distribution on education, natural resources, diversity of economy, community effort to pool financial resources for environment improvement, and community effort to reduce the gap between the haves and the have-nots.

Table 2: (Continued)

Poverty	• Measures of poverty • Incidence of low income by family and individual • Persons in low income family units	• Impact of poverty on education, out and in migration, natural resources, garbage creation, steps taken by the community to reduce garbage creation and to recycle, community cohesion, crime rate in the area, local business and steps taken by the community for the amelioration of poverty.
Real Estate	• Average value of a dwelling • Average gross rent • Owner's major payments on housing • Household payments as a proportion of median income • Percent of owned and rented dwellings • Percent change in owned dwellings	• Impact of real estate prices on the environment, tourism, education, diversity of jobs, community response to the situation, and average monthly income of the people.
Community Perspectives on population and migration	• Impact on economy, social services, and local businesses	• Impact of the category on local businesses, natural resources, education, community cohesion, community resilience to solve problems, fishing and hunting.
Jobs for the taking	• Jobs for the taking	• The impact of jobs availability on environment, community cohesion, and diversification of economy.
Service sector employment expansion	• Service sector employment expansion	• Impact of the category on garbage creation, steps taken by the community to produce less garbage, education, recreation, natural resources and in and out migration.
Seasons of employment	• Seasons of employment	• Impact of the category on migration, seasonal employment, tourism, natural resources, education and town planning.
Middle class employment	• Middle class employment	• Impact of the category on community education, in and out migration, gap between rich and poor, natural resources, per capita income, spending in local business, recreation and community cohesion.
Income and community cohesion	• Income and community cohesion	• Impact of income disparity on education, charitable work done by the rich for the poor, consumption of natural resources in the area, role of income disparity in environment degradation and community resilience.

Employment.

This category was selected by Parkins and Beckley (2001) to study the status of the employment and employment patterns by gender and occupation in the project area (FMF). The indicators developed to study the category of employment are profile indicators (see Table 1), which only inform about the current status of the category. The indicators also fail to establish a link between the three components of the community (ESE). The indicators can be made sustainable community indicators by the addition of more indicators, as seen in Table 2.

Human Capital.

This category was selected to assess the levels of human capital in the project area (FMF), and to compare these levels to provincial and national levels of human capital (see Table 1). The indicators used to study human capital only revealed the percent increase and percent decrease in education levels from 1981 to 1986 in the area (FMF). The indicators have failed to link community dimensions (ESE). The human capital category can be made community sustainable by adding indicators, as seen in Table 2.

Income Distribution.

The indicators selected to assess the sustainability of this category are profile indicators (see Table 1) and only inform about one community dimension (income). The indicators have failed to link the community dimensions (ESE). The indicators for the category (income distribution) can be made sustainable community indicators by adding indicators that take into account the impact of income distribution on the ESE (see Table 2).

Poverty.

This category was selected to measure the extent of poverty in the project area (FMF). The indicators selected to measure poverty are profile indicators that only inform about the status of the poverty category (see Table 1). The indicators present the rise and fall in poverty levels in Alberta and in Hinton, but fail to develop a link between other community dimensions (ESE).

The indicators can be turned into community sustainability indicators by adding indicators that focus on the impact of poverty on the ESE (see Table 2).

Real Estate.

The real estate category was selected and used in the FMF to assess the effects of real estate value on the lives of the local people (see Table 1). This category has only taken into account one community dimension (the value of real estate in the area) and has failed to link it to other community dimensions (ESE). To make this category community sustainable, the indicators that focus on the impact of real estate on the community dimensions need to be incorporated in the format (see Table 2).

Community perspectives on population and migration.

This is a good category of community sustainability, because community views on the population and migration were sought in the FMF (see Table 1). During the interview, the community members expressed their feelings about population and migration in the area.

Communities are usually in a position to perform selection, implementation, monitoring and evaluation of community sustainability indicators on an annual basis. The monitoring of indicators is easy for the community, because they live in the area, and can assess the visible impact of different interventions on their lives and on the area. If the

impact of interventions is in the intended direction, the intervention will be continued and if it is not, then it can be rectified during the process. The indicators to assess the community sustainability of the population and migration category are seen in Table 2.

Jobs for the taking.

This category was selected by the community during the interview process. The focus of the category is only on jobs available to the population in the FMF (see Table 1). It did not link it to other community dimensions (ESE). The category (jobs for the taking) can be made sustainable community category by adding indicators that focus on sector as well as across the sector sustainability (see Table 2).

Service sector employment expansion.

This category provides information about the expansion of local businesses in the FMF over the years, but fails to link it to the community dimensions (ESE) (see Table 1). To link this category to the ESE, the impact of service sector growth on the ESE need to be taken into account (see Table 2).

Seasons of Employment.

This category exhibited unemployment at 12 percent in winter, and at two percent in summer in the FMF (see Table 1). This category is not community sustainable, because it fails to take into account the impact of unemployment on the ESE. To make this category community sustainable, indicators that take into account the impact of seasons of employment on the ESE need to be incorporated into the format (see Table 2).

Employing the Middle class.

The indicator selected to assess the status of this category only informs about the employment status of the middle class in the FMF, it does not take into account the impact of the category on the ESE (see Table 1). Therefore, the category in its present form is not a community sustainable category. This category can be made sustainable by the addition of the indicators that link the category to the ESE (see Table 2).

Income and community cohesion.

The indicator selected to assess the status of this category exhibit that the income disparity has resulted in social divisions among the community in the FMF. The indicator links more than one community dimensions that is economy and society, but fails to report on the amelioration strategy adopted by the community to combat the negative impact of income disparity in the region (see Table 1). This category can be turned into a sustainable community category by adding more indicators to this format that focus on the impact of the category on the ESE (see Table 2).

As a conclusion, Parkins and Beckley (2001) have recommended two essential components of a monitoring framework meant to measure forest community sustainability. First, the indicators identified and selected as a part of the monitoring system should examine the relationship between resource use and socio-economic well-being of the society. Second, process indicators that show a link between the ESE need to be developed.

After reviewing the study, entitled "Monitoring Community Sustainability in the Foothills Model Forest (FMF): A Social Indicators Approach" by Parkins and Beckley (2001), the following observations are made:

- Social indicators used in the study to assess community sustainability in the FMF are good profile indicators, and exhibit sector sustainability;
- Social indicators used in the study in its present form fail to link the community dimensions (ESE); and
- To make the indicators mentioned in the above study sustainable community indicators, additional indicators that focus on linking the community dimensions need to be incorporated in the format (see Table 2).

Section II: Indicators of Sustainable Forest Management Approach

The community sustainability research in forest-based communities started in the 1940s, in Montana (USA), where the stability of timber dependent communities was studied by Kaufman and Kaufman (1946). The study recommended that public participation in forest policy development be increased, local economy be diversified, sustainable timber harvest be promoted, community leadership be promoted, and greater educational and economic assistance to youth be ensured. These recommendations by Kaufman and Kaufman (1946) provided an initial impetus to the promotion of social forestry in the USA. Since then many countries have been active in social forestry such as Australia, Holland and Canada.

In Canada, the Canadian Council of Forest Ministers (CCFM) was established in 1985, to bring together all 14 federal, provincial and territorial ministers responsible for forests. The main responsibility of the council is to facilitate the development of policies and initiatives that lead to sustainable forest management. Since its formation, the CCFM has produced four National Forest Strategies and three Forest Accords (CCFM, 2000).

Despite all the efforts by Canada and other countries to achieve sustainable development, the concept of sustainability has not been standardized; to foresters,

community sustainability was attached to a regular supply of timber to the forest-based industry, which resulted in more and stable jobs for the local community. For the economist, a lower unemployment rate reflects community sustainability, while for poor people adequate food and shelter reflect sustainability (Hart, 1995).

The theme of sustainable development was popularized and standardized by the United Nations Conference on Environment and Economic Development (UNCED) in 1987 through a definition (Hart, 1995). In the same year the National Forest Sector Strategy (NFSS) for Canada was developed by a task force addressing the issue of forest sustainability in Canada (Carrow, 1999).

Despite standardization of sustainable development concepts by UNCED, it is not clear how to measure sustainable development. At the international level efforts were initiated to develop criteria and indicators (C&I) at the national and local levels to monitor progress toward sustainable development. In this regard in September 1993, the Conference on Security and Cooperation in Europe (CSCE) sponsored an international seminar on developing criteria and indicators (C&I) for the assessment of sustainable development in boreal and temperate forests. The conference was held in Montreal, Canada and is called the Montreal Process (Anonymous, 2004).

In 1993, the CCFM formed a task force to launch a public process of consultation with the scientific community and local residents in Canada, to develop a framework of science-based C&I which could be used to measure Canada's progress in the sustainable management of forests (CCFM, 2000).

A working group was formed in Geneva, in June 1994, under the Montreal Process. The working group comprised Australia, Canada, Chile, China, Japan, Republic of Korea, Mexico, New Zealand, Russian Federation and United States of America (USA), and was

made responsible for the development of C&I. Seven criteria of sustainability were developed: (1) Conservation of biological diversity; (2) Maintenance of productive capacity of forest ecosystem; (3) Maintenance of forest ecosystem health and vitality; (4) Conservation and maintenance of soil and water resources; (5) Maintenance of forest contribution to global carbon cycles; (6) Maintenance and enhancement of long-term multiple socio-economic goals; and (7) Legal, institutional and economic framework for forest conservation and sustainable management (Anonymous, 2004).

Canada published a C&I framework in 1995 (CCFM, 2000). In the same year the Sustainable Forest Management (SFM) Network was launched by the Canadian Government. Its goal is to develop an internationally recognized interdisciplinary program that will focus on university-based research (Adamowicz *et al.*, 2001). This process followed on and in 1997, a technical report was produced by the CCFM entitled "Criteria and Indicators of Sustainable Forest Management in Canada: Technical Report, 1997". This report sets out the justification details about the selection of the six criteria for the measurement of sustainable forest management. The selected six criteria are: (1) Conservation of biological diversity; (2) Maintenance and enhancement of forest ecosystem condition and productivity; (3) Conservation of soil and natural resources; (4) Forest ecosystem contribution to global ecological cycles; (5) Multiple benefits to society; and (6) Accepting society's responsibility for sustainable development (CCFM, 2000).

The CCFM (2000) published a report entitled "Criteria and Indicators of Sustainable forest management in Canada, National Status 2000". This report is about the actual application of C&I in Canada, to measure the sustainability of forest management interventions. The message conveyed to scientific and non scientific communities through

this report is that monitoring of sustainable forest management interventions is an adaptive process, which will further develop with the passage of time.

Study Undertaken to Monitor the Forest Community Sustainability by using the Sustainable Forest Management Indicators Approach

The study conducted by Griffin (2001) to measure the forest community sustainability in Lake Abitibi Model Forest (LAMF) is entitled "Lake Abitibi Model Forest (LAMF) Local Level Indicator Status Report: 2000" (Table 3). The LAMF is located in the Boreal forest of Northern Ontario with a total area (land and water) of approximately 1.2 million hectares. The LAMF is a part of the Canadian Model Forest Program (CMFP), initiated by the Canadian Forest Service (CFS) in 1992. The LAMF is playing a lead role in the development, testing, measurement and monitoring of local level indicators of sustainable forest management.

The LAMF involved the LAMF board members, resource managers and the members of the local communities in the identification and selection of the local level indicators of sustainable forest management. The LAMF adopted 37 indicators (after a screening process and field tests), to measure forest sustainability by studying the impact of forest operations on the ESE.

The selected 37 indicators are studied under the six criteria of sustainable forest management accepted by the CCFM (2000) listed on the previous page.

Table 3: Categories, elements and the indicators developed to measure sustainability of the forest in the LAMF (Griffin, 2001).

Criteria (Categories)	Elements	Indicators
Conservation of Biological Diversity	Ecosystem Diversity	• Forest composition and structure • Forests in protected Areas • Level of forest fragmentation, connectedness, and remoteness
	Species Diversity	• Status of species at risk • Status of selected species
	Genetic Diversity	• Implementation of a genetic conservation strategy
Maintenance and Enhancement of Forest Ecosystem Condition and Productivity	Disturbance and Stress	• Level of disturbance in the LAMF • Levels of pollutants and chemicals usage on the forested land • Planned and actual depletions by type and forest Unit
	Processes and Functions	• Changes in forested area • Regeneration success • Silvicultural activities
	Ecosystem Productivity	• Tree growth and productivity • Quantity of forest products harvested vs. sustainable harvest levels (timber and non-timber)
Conservation of Soil and Water Resources	Biophysical Environment	• Soil chemistry and physical structures • Water quality • Hydrological conditions • Status of aquatic fauna
	Policy and Protection	• Soil and water protection

Table 3: (Continued)

Forest Ecosystem Contribution to Global Ecological Cycles	Carbon Cycle	• Net primary productivity • Tree and non-tree biomass • Net carbon flux
	Energy Use	• Fossil fuel consumption in forest management • Processing efficiency
Multiple Benefits to Society	Timber	• Timber production
	Non-Timber Goods and Services	• Extractive goods and recreational/subsistence activities • Non-extractive forest-based recreation and tourism • Intangible goods and services
	Community Sustainability	• Population and employment profile • Family income profile
Accepting Society's Responsibility for Sustainable Development	Investment in the Forest Resource	• Investment in forest based research and development • Capital expenditures in forest resource-based businesses • Extent of aboriginal participation in and satisfaction with forest-based economics opportunities
	Public Participation and Decision- Making	• Public education and participation in decision-making • Aboriginal involvement in forest management planning and the extent to which planning respects aboriginal social, culture, and spiritual values/sites
	Criteria and Indicator Process	• Availability of information required for evaluation of criteria and indicators • Ongoing development and effectiveness of the criteria and indicators process

The indicators selected under each category for the LAMF to assess community sustainability are discussed below.

Conservation of Biological Diversity.

The indicators selected to measure the conservation of biological diversity in the LAMF only provide information about the present status of the category (see Table 3). The indicators selected focus only on ecosystem diversity, species diversity and genetic diversity and do not take into account the impact of conservation of biological diversity on the other components of community (ESE).

To make the category (conservation of biological diversity) community sustainable, more indicators need to be incorporated into the selected format (Table 4).

Table 4: Indicators developed to measure sustainability of the forest in the LAMF, and additional indicators of forest community sustainability

Criteria (Categories)	Indicators	Additional indicators of forest community sustainability
Conservation of Biological Diversity	• Forest composition and structure • Forests in protected Areas • Level of forest fragmentation, connectedness, and remoteness • Status of species at risk • Status of selected species • Implementation of a genetic conservation strategy	• How is the conservation of biological diversity contributing to the welfare of forest community? • Increase in wildlife population? • How is increase in wildlife regulated through hunting? • Are local communities becoming more aware of the importance of biological diversity to them? • Impact of the biological diversity conservation on forest cutting pattern? • Implementation level of laws related to biodiversity conservation.
Maintenance and Enhancement of Forest Ecosystem Condition and Productivity	• Level of disturbance in the LAMF • Levels of pollutants and chemicals usage on the forested land • Planned and actual depletions by type and forest Unit • Changes in forested area • Regeneration success • Silvicultural activities • Tree growth and productivity • Quantity of forest products harvested vs. sustainable harvest levels (timber and non-timber)	• Community awareness level regarding forest ecosystem and productivity of forests? • Impact of this category on wildlife population of key species found in the area, present logging regime in the area, retail business, manufacturing business, real estate value, recreation, community resilience, water resources, community education and hunting.
Conservation of Soil and Water Resources	• Soil chemistry and physical structures • Water quality • Hydrological conditions • Status of aquatic fauna • Soil and water protection	• Impact of the category on natural resource, community awareness about water and soil resources, community resilience to counteract positively any problem, erosion control, status of biodiversity and local businesses.

Table 4: (Continued)

Forest Ecosystem Contribution to Global Ecological Cycles	• Net primary productivity • Tree and non-tree biomass • Net carbon flux • Fossil fuel consumption in forest management • Processing efficiency	• Impact of the category on community efforts for renewable energy, community awareness regarding energy use, workshops held to inform people about the wise use of energy, community resilience to react positively in handling problems, technical education and local businesses.
Multiple Benefits to Society	• Timber production • Extractive goods and recreational/subsistence activities • Non-extractive forest-based recreation and tourism • Intangible goods and services • Population and employment profile • Family income profile	• Impact of the category on community resilience to react positively to handle any situation, community awareness level about the importance of natural resources, workshops held for the community regarding capacity development in natural resources management, community education, environment and local businesses.
Accepting Society's Responsibility for Sustainable Development	• Investment in forest based research and development • Capital expenditures in forest resource-based businesses • Extent of aboriginal participation in and satisfaction with forest-based economics opportunities • Public education and participation in decision-making • Aboriginal involvement in forest management planning and the extent to which planning respects aboriginal social, culture, and spiritual values/sites • Availability of information required for evaluation of criteria and indicators • Ongoing development and effectiveness of the criteria and indicators process	• Existence of community committee, decisions taken and implemented by the community, satisfaction of community, impact of community decisions on: interrelationship between timber companies and communities, natural resources and skills development of the people.

Maintenance and Enhancement of Forest Ecosystem Condition and Productivity.

The indicators developed for this category focus on the following elements: disturbance and stress, process and functions and ecosystem productivity (see Table 3). The indicators have addressed the issue of sector sustainability by assessing the present status of the elements. However, the indicators have failed to address across the sectors sustainability, by failing to take into account the impact of the elements on the ESE.

To make this category community sustainable, the impact of the interventions to maintain and enhance ecosystem condition and productivity need to be studied in the category. To achieve this objective, the impact of the category on the ESE must be included in the present format (see Table 4).

Conservation of Soil and Water Resources.

The indicators developed to assess the status of this category (conservation of soil and water resources) focus on two elements: biophysical environment and policy, and protection (see Table 3). In this category the sector sustainability has been adequately addressed, by assessing the present status of the category. However, across the sector sustainability has been ignored by not linking the category to the three components of community (ESE).This category can be made sustainable by studying the impact of the category on the ESE (see Table 4).

Forest Ecosystem Contribution to Global Ecological Cycles.

To assess the status of this category (forest ecosystem contribution to global ecological cycles) indicators are developed for two elements: carbon cycle and energy use (see Table 3). The developed indicators have addressed the issue of sector sustainability by assessing the present status of carbon cycle and energy use. Across the sector sustainability is not

taken into account by ignoring linkage across the ESE. Therefore, this failure makes it an unsustainable community category and indicators. To make this category community sustainable, the impact of the category on the ESE must be included in the format (see Table 4).

Multiple Benefits to Society.

The indicators developed to study this category (multiple benefits to society) are profile indicators (timber, non-timber goods and services, community sustainability) because they provide information only about the present status of the category (see Table 3). In the present format across the sector sustainability is ignored by not taking into account the impact of the variable on the economy and environment. To make this category community sustainable, the indicators that inform about the impact of this category on the environment and economy must be included in the format (see Table 4).

Accepting Society's Responsibility for Sustainable Development.

The indicators developed to assess the status of this category are investment in the forest resource, public participation and decision making, and criteria and indicator process (see Table 3). These indicators failed to demonstrate across the sector sustainability by not taking into account the impact of the category on the economy and community. To make this category community sustainable, the suggested indicators are seen in Table 4.

The data for the indicators can be retrieved from government statistics, independent research, community monitoring committees, town committee records, and from local businesses.

At the end of the review for this study, one point is clear, in order to achieve community sustainability, the indicators selected in a category (e.g., population) should

focus on the following issues: what is the current status of the indicators, what is the impact of the indicators on the community, economy, education, recreation and environment.

Section III: Sustainable Community Indicators Approach

The quest for the identification and selection of sustainable community indicators is still occurring and will continue into the future until the concept of sustainable development is standardized. The major shift from the development of social indicators to sustainable community indicators was initiated by countries such as Canada, after the release of the Brundtland Commission Report (Our Common Future), in 1987. In this report the definition of sustainable development was standardized "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNCED, 1987). Since publication of the sustainable development definition by UNCED (1987), there is no consensus among the scientific community about sustainable community or sustainable development standards.

Hart (1995) produced a guide of sustainable community indicators. This guide of sustainable community indicators is a compilation of analyzed indicators. This guide of indicators lacks the true sense of sustainable development, because the indicators focus on sector sustainability and fail to take into account the impact of selected categories on the ESE.

Indicators are developed by scientists in the context of their understanding of sustainable development. For example, Parkins and Beckley (2001) have called their developed social indicators as sustainable community indicators in their study discussed under "social indicators approach" earlier in this report.

Parkins *et al.* (2001) employed sustainable community indicators in the Prince Albert Model Forest (PAMF), and called the indicators as sustainable community indicators, because the indicators were developed by the local communities. Selection of indicators by local communities is one component of community sustainability, but the developed indicators may not be community sustainability indicators. The most important aspect of community sustainability indicators is that the indicators developed must reflect impact of the categories, such as population and employment on the ESE.

Study Undertaken to Monitor the Forest Community Sustainability by using the Sustainable Community Indicators Approach

Parkins *et al.* (2001) carried out research to measure the sustainability of forest communities in the PAMF. The PAMF comprises 367,000 ha of a mixed wood section of the southern boreal forest, 70 km north of Prince Albert, Saskatchewan.

The study is entitled "Locally defined Indicators of Community Sustainability in the Prince Albert Model Forest". The three communities studied in the Prince Albert Model Forest (PAMF) are: Candle Lake, Montreal Lake, and Waskesiu Lake in Saskatchewan.

To develop sustainable community indicators in the PAMF, three tools were used for the purpose. First, a workshop was held for the representatives of the local communities from the project areas. In the workshop the communities discussed their day to day life and came up with a list of indicators of quality of life.

Second, indicators developed by the communities were evaluated on the basis of a framework developed from three sources:

- The sustainable community indicators of the Computer Research Laboratory for the Environment, University of Guelph, Ontario (CRLE, 1999);
- The North Central Regional Centre for Rural Development, Iowa State University, Ames, Iowa (Flora *et al.*, 1999); and
- Indicators of sustainability (Hart, 1999).

The evaluation framework focused on two dimensions: relevance of indicators to sustainability, and effectiveness of indicators. Based on the indicators effectiveness and relevance to sustainability a list of 22 indicators was developed. Third, a survey was conducted, in which a list of 22 indicators was sent out to the community members who were asked to rank the indicators by using a scale from 1-7 (1= not at all important, and 7=extremely important) (Table 5). The community members were also asked to pick three very important indicators based on their ranking.

The list of indicators developed by the Candle Lake community show that the residents of the Candle Lake are seasonal, and majority of them are retired senior citizens (Table 5). Therefore, their interests are different from the Montreal Lake residents who are year round.

Table 5: Prioritized indicators for Candle Lake (Parkins *et al.*, 2001)

Indicators	Mean Score	Points
• Restrictions that minimizes water pollution	6.7	42
• Peace and quiet	6.2	38
• Fair and equitable property tax rates	6.8	36
• Food, Health care and education available within the community	5.7	22
• Public involvement in local decision making	6.2	16
• Maintaining wildlife populations	6.6	14
• Access to nature	6.4	14
• Existence of wilderness in the local area	6.3	13
• Ability to maintain community services	6.2	10
• Maintaining a natural forest landscape undisturbed by humans	5.7	10
• Maintaining and fostering vacationer economy	5.5	5
• Enforcement of recreational regulations	6.2	4
• A sense of belonging to the community	5.9	4
• A family oriented community	5.9	3
• Employment in natural resource industries	4.8	3
• Availability of local recreational opportunities	5.9	2
• Low unemployment	5.2	2
• Encouraging the development of Candle Lake as an arts community	4.4	1
• Increasing employment incomes	4.3	1
• Fostering community wide events	5.3	0

Mean score=1-7 (1= not at all important, 7= extremely important)
Points=Sum of ranking of three most important items to the community.

Candle Lake.

The selected indicators amply display the seasonal nature of the community in Candle Lake, because more focus is on provision of services like fair and equitable tax services, and access to nature. In the indicators list "fostering community wide events" recorded 5.3 points which mean it is an important indicator but in ranking received 0 points. On the other hand "increasing employment income" was scaled at 4.3 and in ranking received 1 point. Indicator "peace and quiet" was scaled at 6.2 and received 38 points in ranking. The indicators selected are outlined below.

Restrictions that minimizes water pollution.

It is a good community sustainability indicator because with enforcement of such restrictions the water quality will improve, which will have a positive impact on the health of the local people and also on the river biodiversity (see Table 5). The indicator will also enhance community awareness levels about pollution and its harmful effects. To assess the sustainability of this indicator, the suggested indicators are given in Table 6. The data for the indicators can be retrieved from community records, Ministry of Natural Resources and Statistics Canada.

Table 6: Prioritized indicators for Candle Lake, and additional indicators of community sustainability

Indicators	Additional indicators of community sustainability
Restrictions that minimizes water pollution	• Any restrictions developed by the stakeholders that will minimize water pollution, are the restrictions developed by the stakeholders or by somebody else, implementation level of the restrictions, monitoring status of restrictions, number of violations reported, any strategy in place for curbing violations, and impact of restrictions on water quality and on river biodiversity.
Peace and quiet	• Number of cases related to violence reported at the police station, existence of community conflict resolution committee, number of local conflicts resolved by the community and by the police, impact of the community committee on community cohesion, and on tourism and local businesses.
Fair and equitable property tax rates	• Satisfaction level of community with the present tax rates, impact of community satisfaction with tax rates on local business, impact on resource use, impact of the variable on environment improvement or deterioration, income distribution in the area, and impact of the variable on community resilience to skillfully handle any problem related to natural resources or other society components.
Food, Health care and education available within the community	• How is food contributing to well-being of community and environment, contribution of health care to environment deterioration, contribution of healthy society to environment improvement, economy and community, kinds of education imparted, are the educated people absorbed in local economy, and is education playing any role in environment protection.
Public involvement in local decision making	• Existence of stakeholders committee, number of decisions taken by the committee, implementation level of community decisions, acceptance of community decisions by the Government, and trainings conducted by the committee to improve local level capacity in decision making.

Table 6: (Continued)

Maintaining wildlife populations	• How wildlife is contributing to stable societies, what is the impact of wildlife population on the environment, wildlife contribution in boosting local economy, impact of wildlife on forest operations, and community education.
Access to nature	• Contributing to increase in recreation, efforts made by the local community to promote eco-tourism in the area, contribution of this indicator to local economy, impact of the indicator on in and out migration, on local environment and local education.
Existence of wilderness in the local area	• Contribution of this indicator to environment improvement, impact on community awareness about the importance of wilderness areas, impact on wildlife population in an area, impact on forest operations in the area, impact on game hunting in the area, and contribution to local economy and to local education.
Enforcement of recreational regulations	• Define visitors, fix number of visitors, declare areas free of tree cutting, fix entry fees to the area, determine camp site locations, minimize visitors impact on the natural resources, and bring diversification to the local economy.
A sense of belonging to the community	• Working for community cohesion, helping out the poor of the area through a charity program, establishment of cultural centers for gathering, and training programs for skills enhancement. With these indicators a viable link between different components of the society is established. The data for these indicators can be collected from community records, independent research, surveys and community interviews.
Employment in natural resource industries	• Percent contribution of forestry jobs to the local economy, impact of forest operations on the environment, impact of the variable on tourism, percent area cut and percent area reforested each year, growth of other industries, and government subsidies for starting a business in the area.

Peace and quiet.

It is a good sustainable community indicator as it will inform about the interaction status of different society components (see Table 5). If the interaction is normal within the community components (ESE), peace and quietness will prevail. The indicator (peace and quiet) can be measured by employing the indicators as seen in Table 6. The data for the indicators can be collected from Statistics Canada, local police stations and community records.

Fair and equitable property tax rates.

To establish a sustainable community, it is very important to address the community concerns related to taxation or any other matter (see Table 5). In its present form the indicator is not a sustainable community indicator, because the indicator only highlights the importance of fair and equitable tax rates and does not take into account the impact of the indicator on ESE. To make this indicator sustainable community indicator, more indicators that focus on the impact of the indicator on the ESE need to be developed (see Table 6).

Food, health care and education available within the community.

It is a sustainable community indicator because food, health and education are the basic requirements of any community (see Table 5). To assess the sustainability of this indicator, the questions that need to be answered are given in Table 6.

Public involvement in local decision making.

Public involvement in local decision making process is a sustainable community indicator (see Table 5). The effectiveness of this indicator can be assessed with the indicators as seen in Table 6.

Maintaining wildlife populations.

This indicator is a sustainable community indicator, because it informs about the status of wildlife in an area (Table 5). The effectiveness of this indicator can be determined with the indicators as seen in Table 6.

Access to nature for recreational purpose.

This indicator in its present form is not a sustainable community indicator, because it does not convey anything about the impact of this indicator on other community components (ESE) (see Table 5). This indicator can be turned into a sustainable community indicator with the addition of indicators seen in Table 6.

Existence of wilderness in the local area.

Existence of wilderness areas will serve as a bench mark to assess the health of forests within the area. In its current form this indicator is not a sustainable community indicator because it only informs about the existence of wilderness in an area (see Table 5). This indicator can be turned into a sustainable community indicator with the addition of indicators as seen in Table 6.

Enforcement of recreational regulations.

This is an important indicator of community sustainability, because regulations will ensure wise use and protection of the area (see Table 5). The effectiveness of this indicator in regard to forest community sustainability can be assessed from the indicators as seen in Table 6.

A sense of belonging to the community.

This indicator indicates the community commitment towards societal uplift (see Table 5). The community commitments are seen in Table 6.

Employment in natural resources industries.

This indicator will present the degree of community dependency on natural resources and will also provide information about the economic base of the area (see Table 5). If the level of dependency on a natural resource is great, and the natural resource is not managed sustainably, then the local communities will eventually get in trouble. The local residence dependency on natural resources jobs will not allow them to plan for diversification of their economic base, and on the depletion of the resource it ultimately will result in situation like Newfoundland. In Newfoundland, when the population of cod fish was high, it was the main source of employment for the local residents. But when the cod fish resource got depleted, due to over-fishing, people lost their jobs and started to move out of the area in search of jobs.

The indicators given in Table 6 will assess the forest community sustainability. The information on the indicators can be obtained from timber companies, Ministry of Natural Resources, other local businesses, independent research and from community monitoring records.

Montreal Lake.

The indicators selected by the Montreal Lake community mainly focus on community health, housing, income and family (Table 7). The indicator "access to nature" received 6.6 a mean score but did not receive any points. This failure of the indicator is due to the option given to the local residents to select three most important indicators of quality of life. Due to this option important indicators scored low in the points table. The sustainability of the selected indicators is discussed below.

Table 7: Prioritized indicators for Montreal Lake (Parkins *et al.*, 2001)

Indicators	Mean score	Points
• Physical, mental, and spiritual health of residents	6.5	43
• Availability of band housing	6.4	24
• Increasing employment incomes	6.4	22
• Stable homes and families	6.4	22
• Food, health care, and education availability within the community	6.8	21
• Access to the traditional knowledge	6.5	20
• Number of residents who speak Cree	6.1	20
• Low unemployment	6.0	17
• Wages that meet basic needs	6.2	11
• Peace and quiet	5.8	9
• Access to wild game meat such as moose	6.2	6
• A sense of belonging to the community	6.6	6
• A family oriented community	6.4	5
• Maintaining wildlife populations	6.4	5
• Employment in oil, gas or in forest	5.4	5
• Ability to maintain community services	6.6	3
• Involvement of off reserve band members in community life	5.9	3
• Access to public transportation	5.8	0
• Freedom from unwanted outside interference	5.2	0
• Access to nature	6.6	0

Mean score=1-7 (1=not at all important, 7=extremely important)
Points=Ranking based on top three selection by each respondent from the community

Physical, Mental, and Spiritual Health of Residents.

It is a good sustainable community indicator, which scored high on both the scale and points table (see Table 7). To study this indicator (physical, mental and spiritual health of residents), indicators that will show the present status of the indicator need to be developed. For this indicator data can be collected from the local hospitals, clinics and health units. Data for spiritual health can be measured from the satisfaction level of the community (data to be collected). Once the status of the indicator is known, the next step is to find the impact of the indicator on: economy, forests, community resilience to handle problems and community education.

Availability of Band Housing.

This indicator in its present form is not a sustainable community variable (see Table 7). The indicator can be made sustainable community indicator by undertaking the following measures: first, the present status of the band housing availability will be assessed (data for this purpose can be collected from municipal corporations); and second the impact of the indicator (availability of band housing) on the environment, economy and community resilience need to be ascertained.

Increasing Employment Incomes.

This indicator in its present form is not a community sustainability variable (see Table 7). To assess the effectiveness of this indicator, two sets of indicators need to be developed. One set of indicators must focus on the present status of the indicator (e.g., per capita income, total household income and major source of income). The second set of indicators developed for the indicator (increasing employment incomes), will focus on the impact of

the indicator on local businesses, forestry resource, community resilience, recreation, hunting, waste generation and community education.

The remaining indicators (see Table 7) in their present form are also not community sustainability indicators. This is because they involve just simple statements about an activity. To make an indicator community sustainable, two set of indicators need to be developed. One set of indicators must focus on the present status of the variable. The second set of indicators must focus on the impact of the indicator on the ESE.

METHODOLOGY

The methodology adopted on this study to develop a suitable framework for the development of sustainable community categories and indicators is based on the frameworks suggested by Hart (1995) and Maclaren (1996). The developed framework is a combination of sector based community sustainability framework, domain-based community sustainability framework, COMLE model, community capacity model, and community resilience model (Table 8). The indicators developed in this framework will also have the following qualities: relevant, understandable, reliable and timely. The target audience of this framework is the stakeholders (with focus on local communities) involved with the assessment of community sustainability. The other advantages of this framework are: its main focus is on community sustainability; and the framework is very simple and can easily be used by the local communities.

The framework employed to develop sustainable community indicators at a local level is presented in Table 8.

Table 8: Sample framework displaying the process of Sustainable Community Indicators development in this study.

Categories	Variables	Indicators
1. Population 2. Employment 3. Education 4. Poverty 5. Forest operations	• Present status of each category • Impact of each category on environment • Impact of each category on economy • Impact of each category on community	Indicators developed to monitor the categories should demonstrate sector sustainability as well as across the sector sustainability. To achieve sector sustainability for each category (e.g., population) the focus of indicators will be on total population, in and out migration, and age distribution by gender. To achieve across the sector sustainability, the impact of the status of population on environment, economy, and society will be taken into account. The framework will include indicators of stress, condition, and community response to a particular situation for each category.

RESULTS

SUSTAINABLE COMMUNITY INDICATORS DEVELOPED FOR THE CATEGORY OF POPULATION

The sustainable community indicators were developed for the category of population (Table 9). Four sets of indicators are developed to assess sustainability of population in any area. The first set of indicators focus on the present status of population; which provides information about total population, age distribution by gender, and migration pattern in the area. The focus of the first set of indicators brings sector sustainability to the process. The second set of indicators developed provides information about the impact of the status of population (first set of indicators) on environment. The third set of indicators provides information about the impact of the status of population (first set of indicators) on economy. The last set of indicators developed focuses on the impact of the population (first set of indicators) on community. By focusing on the impact of the population indicator on ESE this will ensure across the sector sustainability. The data for the indicators can be retrieved from Statistics Canada, or from other government or non-government agencies. If there is a lack of data then the data will be collected by local communities.

Table 9: Sustainable community indicators developed for the category of population

Population	
Sustainable community variables	Sustainable community indicators
Present status of population category	• Total Population • Age distribution by gender • In and out migration
Impact of population on environment	• Is the increase or decrease in population producing more waste? • Local dependency on forestry resource has increased or decreased? • Status of fishing due to increase in population? • Increase in the number of auto-mobiles due to increase in population? • Status of effluent outlets to the water bodies? • Status of the quality of air due to population increase? • Status of hunting due to population increase or decrease? • Status of wildlife found in the area? • Impact on Biodiversity Conservation plans?
Impact of population on economy	• Increase or decrease in retail business due to the status of population? • Is there any impact of population on tourism? • Status of manufacturing business affected by the population growth? • Increase in population has any impact on real estate values?
Impact of population on community	• Steps taken by the community committee for the recuperation of bad indicators? • Number of meetings held by the committee quarterly? • Level of implementation of decisions by community? • Community health? • Community education? • Community cohesion?

SUSTAINABLE COMMUNTY INDICATORS DEVELOPED FOR THE CATEGORY OF EMPLOYMENT

Sustainable community indicators were developed for the category of employment (Table 10). The category of employment is divided into four sections. The first section is the status of the employment category; the indicators developed for this section provides information about sector sustainability. The second section, the impact of the employment category on environment, provides information about how the environment is affected by the status of employment in the area. The third section, the impact of employment category on the economy, provides information about the contribution of the employment category to the local economy. The fourth section, the impact of employment category on the community, provides information about how community is affected by the employment, and how is the community responding to face the challenges. The assessment of the impact of employment category on environment, economy and community will ensure across the sectors sustainability. The data for the indicators can be retrieved from Statistics Canada, Ministry of Natural Resources and community records. If there is a lack of data then the data will be collected by local communities.

Table 10: Sustainable community indicators developed for the category of employment

Employment	
Sustainable community variables	Sustainable community indicators
Present status of employment in the area	• Employment rate • Female participation in labor force • Male participation in labor force
Impact of employment on environment	• Is the increase in employment contributing to more waste creation? • Is the employment rate increasing or decreasing local dependency on forest resource? • Is there decrease or increase in legal fishing due to employment rate? • Number of parties caught doing illegal fishing? • Effluent discharge to the river?
Impact of employment on economy	• Number of new retail businesses established due to employment status? • Number of locals and outsiders visiting the area for recreation? • Number of manufacturing units in the area? • Value of real estate in the area? • Number of privately owned cars?
Impact of employment on community	• Is there any community committee? • Number of decisions taken by the committee for the recuperation of bad indicators? • Level of decisions implementation? • Availability of loans on soft terms to community to initiate a business? • Number of skills development centers? • Kind of skills development? • Community help center for poor? • Rehabilitation planning for poor people by the community committee? • Number of people visiting local hospital and walk-in clinics? • Impact on per capita income?

SUSTAINABLE COMMUNITY INDICATORS DEVELOPED FOR THE CATEGORY OF EDUCATION

Sustainable community indicators are developed for the category of education (Table 11). The initial set of indicators developed focus on the present status of the category (education), which will provide information about an increase or decrease in the education in the area. The second set of indicators, assess the role of the education in environment improvement. The third set of indicators, ascertain the contribution of the education to the local economy. The final set of indicators, assess both the resilience of local communities to skillfully handle problems and the impact of education on local communities. Sector sustainability is assured by the first set of indicators, because it provides a basis for planning. Across the sector sustainability is determined by taking into account the impact of the education category on environment, economy and society as discussed above. The data for the indicators can be retrieved from Statistics Canada, Ministry of Natural Resources and community records. If there is a lack of data then the data will be collected by local communities.

Table 11: Sustainable community indicators developed for the category of education.

Education	
Sustainable community variables	Sustainable community indicators
Present status of education category	• Literacy rate • Change in full time school attendance • Change in educational attainment • Highest level of education • Number of colleges operating in the area • Disciplines taught in the colleges
Impact of education on environment	• Is community education contributing to reduction in waste creation? • Is there decrease in local dependency on forests due to education? • Are people aware about the wise use of natural resources? • Is community education helping in the implementation of fishing plans? • Incidences of illegal fishing? • Use of automobiles growing or decreasing in the area? • Are people aware about the negative impacts of effluents discharge into water systems? • Is there any decrease in illegal hunting? • Is there increase or increase in the number of wildlife? • Formulation of natural resources conservation plans?
Impact of education on economy	• Increase in per capita income due to education? • Is the retail business growing or decreasing due to community education? • Number of trained tourism guides in the area? • Is the local manufacturing business growing? • Are the educated people finding jobs in the manufacturing sectors? • Is community education contributing to the business in real estate?
Impact of education on community	• Presence of community committee in the area? • Number of meetings held monthly or yearly? • Attendance percentage by the committee members? • Number of decisions taken by the committee for the recuperation of the bad indicators? • Implementations level of the committee decisions? • Community recreation? • Community health? • Monitoring level of the plans? • Measures taken to introduce eco-friendly behavior? • Is there any effort undertaken by the community to advertise tourism potential of the area?

SUSTAINABLE COMMUNITY INDICTAORS DEVELOPED FOR THE CATEGORY OF POVERTY

The sustainable community indicators developed for the category of the poverty address both the present status of poverty in the area, and the impact of poverty on the ESE (Table 12). The indicators developed to assess the present status of the poverty ensure sector sustainability. Across the sector sustainability is achieved by taking into account the impact of poverty category on the ESE. The data for the indicators can be retrieved from Statistics Canada, Ministry of Natural Resources and community records. If there is a lack of data then the data will be collected by local communities.

Table 12: Sustainable community indicators developed for the category of poverty.

Poverty	
Sustainable community variables	Sustainable community indicators
Present status of poverty category	• Incidence of low income by family and individual? • People living in low income family units? • In and out migration? • Earnings spent on grocery and rent? • Number of people on social assistance?
Impact of poverty on environment	• Is fisheries resource under pressure due to poverty? • Is poverty contributing to air pollution and poor water quality? • Is the status of wildlife affected by poverty? • Is poverty contributing to increase or decrease in waste creation? • Is poverty a factor in increasing the dependency of communities on forestry resource? • Impact of poverty on the formulation and implementation of Biodiversity Conservation plans?
Impact of poverty on economy	• Is local retail business growing or decreasing due to poverty? • Is poverty hampering the growth of tourism industry? • Number of manufacturing units operating in the area? • Percent decrease in the value of real estate due to poverty? • Impact of poverty on per capita income?
Impact of poverty on community	• No of decisions taken by the community for recuperation of the bad indicators? • Level of decisions implementation? • Government help to the community? • Community help center for poor? • Availability of loans on soft terms to the community to initiate a business? • Number of skills development centers? • Impact of poverty on education? • Impact on community recreation? • Impact on community health?

SUSTAINABLE COMMUNITY INDICTAORS DEVELOPED FOR THE CATEGORY OF FOREST OPERATIONS

The category of forest operations is divided into four sections (Table 13). The indicators developed for the first section provides information about the present status of the forest operations. The indicators developed for the second section provides information about the impact of the forest operations variable on environment. The indicators developed for the third section focus on the impact of the forest operations on economy. Finally, indicators developed for the fourth section provides information about the impact of the forest operations on the community and community resilience to handle problems skillfully. The data for the indicators can be retrieved from Statistics Canada, or from other government or non-government agencies. If there is a lack of data then the data will be collected by local communities.

Table 13: Sustainable community indicators developed for the category of forest operations.

Forest Operations	
Sustainable community variables	Sustainable community indicators
Present status of forest operations category	• Number of timber companies operating in the area? • Types of machines used by the companies in forestry operations? • Silvicultural system employed in the area for the management of the forest? • Implementation level of the management plans?
Impact of forest operations on local environment	• Type of waste created by forest operations? • Amount of Waste created during forest operations? • Is the waste created properly disposed off? • Impact of forest operations on erosion? • Reforestation of the cut area? • Level of beating up operation? • Impact of forest operations on turbidity of streams? • Impact of stream turbidity on the population of major fish species found in the area? • Role of forest operations in changing the wildlife population of the area?
Impact of forest operations on local economy	• Jobs provided by the timber company? • Is the retail business growing or slowing down due to forest operations? • What impact do forest operations have on local tourism? • Type of manufacturing units in the area? • Is the manufacturing business growing due to forest operations? • Any role of forest operations in the value determination of real estate?
Impact of forest operations on community	• No of decisions taken by the community committee for the amelioration of bad indicators? • Level of decisions implementation? • Steps taken by the community to diversify the economy? • Impact on community education? • Impact on community health? • Impact on community cohesion? • Level of community monitoring the forest operations?

The format in which the indicators are developed for each category in this study makes the indicators sustainable community indicators, because in each category the initial focus is on the present status of the category, and then followed by the indicators focusing on the impact of each category on the ESE.

COMPARISON OF RESULTS OF THIS PROJECT TO THE RESULTS OF THE STUDIES DISCUSSED IN THE REVIEW OF LITERATURE

Results of the three studies discussed in the literature review are compared to the results of this project entitled "Review and Synthesis of the Sustainable Community Indicators used in Monitoring Forest Communities Sustainability" (Appendix II). The comparison parameters are: sector sustainability, linkage developed across the sectors and complete sustainability. Sector sustainability will cover information related to the present status of the categories. Linkage across the sectors will be established, when the impacts of the categories on the local environment, economy and community are taken into account. Finally, complete sustainability will be achieved, when individual indicators or a group of indicators meet both requirements of the sector, as well across the sector sustainability.

The social indicators approach used by Parkins and Beckley (2001), to assess forest community sustainability in the FMF, has provided important information about the status of each sector as discussed in the literature review. However, the indicators developed have failed to assess complete sector sustainability as well as across the sectors sustainability. Complete sector sustainability is ignored by not including indicators which focus on correction of bad indicators. For example, if out migration is high, there are no indicators in the framework that show the way to tackle out migration. Across the sector sustainability is also ignored by not taking into account the impact of the categories on the ESE (Appendix II).

The sustainable forest management indicators approach employed in the LAMF, to assess sustainability of forest communities, will only achieve sector sustainability related to forest ecosystem (Appendix II). The indicators in their current form cannot achieve sustainable development, because impact of the forestry sector on economy and community is not taken into account (discussed under review of literature). The formats failing to achieve across the sectors sustainability will not result in sustainable development, because the progress in one sector might be at the expense of deterioration in another sector.

The sustainable community indicators approach adopted by Parkins *et al.* (2001) in the PAMF, to assess forest community sustainability, failed to achieve complete sector sustainability as well as across the sector sustainability (Appendix II). The complete sector sustainability is ignored by not taking into account indicators that show remedial measures undertaken to correct bad indicators. The across the sector sustainability is ignored by not taking into account the impact of categories on the environment, economy and society. There is also a lack of structure in the format with no variables. The indicators in individual capacity as well as in a set of indicators have also failed to achieve across the sector sustainability.

Indicators developed in this study entitled, "Review and Synthesis of Sustainable Community Indicators used in Monitoring Forest Communities Sustainability" are sustainable community indicators (Appendix II). Indicators are developed for the categories of population, employment, education, poverty and forest operations. Indicators are developed to assess the present status of the categories to ensure sector sustainability. To ensure across the sector sustainability, indicators are developed to assess the impact of the present status of the categories on the environment, economy and society. The

indicators developed to assess community resilience focus on the efforts made by the community to fix bad indicators. Therefore, indicators developed in this study will be indicators of community sustainability, because the indicators have successfully met all requirements of sustainability.

DISCUSSION

Different frameworks are suggested by scientists such as Hart (1995), and Maclaren (1996) for the assessment of community sustainability. Most of the scientists agree that the framework developed to monitor community sustainability should focus on sector sustainability, as well as across sectors sustainability. Sector sustainability assessment will include indicators that focus on the present status of categories, and indicators that focus on correction of bad indicators. Across the sector sustainability will include impact of each category on the ESE.

The frameworks recommended by Hart (1995), and Maclaren (1996), for development of sustainable community indicators, failed to achieve the objective of sector, as well as across sectors sustainability. The main reason for this failure was ignoring the guidelines of the framework given for indicators development. For example, in the case of COMLE model, the recommendation was to include indicators of stress, condition and response for each category in a format of sustainability assessment. The final format of COMLE model included indicators of stress and condition only. For example, to assess sustainability of the housing category, the components selected are: economic vitality, social well-being and environmental integrity. To assess economic vitality of the housing, the indicator selected was employment. To assess social well-being of the housing category, the indicators selected are: affordability, suitability, adequacy and accessibility. Finally, to assess the environmental integrity of the housing category, the indicators selected are: density, and design. There are no indicators for the community resilience or the community response to bad indicators.

The social indicators approach adopted by Parkins and Beckley (2001) to monitor forest community sustainability in the Foothills Model Forest (FMF) is a very good example of the application of this approach. In the study, the main area of focus of the social indicators is on sector sustainability. The indicators selected to monitor the population and migration only focus on the status of the population and migration. They do not take into account the impact of the population and migration on the ESE, which is the essential ingredient of community sustainability. Therefore, the social indicators approach used by Parkins and Beckley (2001), to assess community sustainability; failed to address the core issue of community sustainability.

The sustainable forest management indicators used in the Lake Abitibi Model Forest (LAMF) to monitor forest community sustainability mainly focused on six principles of sustainability. These are the principles developed by the Canadian Council of Forest Ministers (CCFM) in 1995.

The indicators developed to study each principle only focuses on one aspect of each principle. For example, the criterion conservation of biological diversity is divided into three elements: ecosystem diversity, species diversity and genetic diversity. The indicators developed to monitor ecosystem diversity only focus on the status of ecosystem diversity, and treat it in an isolated pocket. The impact of the status of ecosystem diversity on the ESE is ignored. This format does not take into account the holistic approach of sustainability assessment, which is the corner-stone of sustainable development and the community sustainability.

The other principle used in the LAMF, is accepting society's responsibility for sustainable development. The elements developed for this category are: investment in the forest resource, public participation and decision making and criteria and indicator

development process. The elements developed here are a step in the right direction for the assessment of community sustainability. But, in the process of indicators development to monitor the elements, the component of sustainability is lost, because the focus of the indicators is only on one component of that particular element. Therefore, the indicators developed treat the elements as an isolated pocket.

Parkins *et al.* (2001), employed sustainable community indicators to monitor sustainable development at the community level in the Prince Albert Model Forest (PAMF). The indicators developed with local community assistance are sustainable community indicators, but lack a proper structure (no variables). The disadvantage of such a framework is that the sector, as well as across the sector sustainability is ignored.

The answer to the missing links in the indicators development in the PAMF is provided by the framework adopted in this study. The framework has focused on the sector, as well as across the sector sustainability by developing a number of social, environmental and economic indicators for each category.

The framework produced in this study, treats every activity or category as a unit, and then the category is divided into four variables. The first variable focuses on the present status of the category; this variable provides information about the existing condition of the category. The second variable of the framework provides information about the impact of the present status of the category on the environment. The third variable of the framework provides information about the impact of the present status of the category on the economy. Finally, the fourth variable provides information about the impact of the present status of the category on the community; it also assesses community resilience. The community resilience includes the response of the community and other stakeholders to correct bad indicators. In this framework both the sector sustainability, as

well as across the sector sustainability of the categories is addressed. Sector sustainability is addressed by the indicators in the first section of the framework; that informs about the existing condition of each category. Across the sector sustainability is addressed by taking into account the impact of the existing status of each category on the environment, economy and community. The impact of the category on the community includes response of the community to a particular situation.

CONCLUSION AND RECOMMENDATION

Sustainable development is a complex topic, and so is its monitoring at the community level (the first step in achieving sustainability). The three studies reviewed in the literature are based on three different approaches to assess the forest community sustainability (social indicators approach, sustainable forest management indicators approach and sustainable community indicators approach). The literature review highlighted the deficiencies of each approach in assessing the forest community sustainability. The major focus of all the three studies is on sector sustainability, that is, data is only collected about the present status of the categories.

The format developed in this study to assess the forest community sustainability is based on a holistic approach that takes into account the present status of each category, and then assesses the impact of each category on the ESE. This is a step towards standardization of the method of forest community sustainability assessment.

The results of this study also indicate that forest community sustainability assessment with a single indicator or with indicators without a format is not advisable.

The framework developed for the study of sustainable community indicators should focus on a holistic approach. That is, the indicators developed to study the sustainability of a category should be a combination of social, environmental and economic indicators. The holistic approach will ensure sector as well as across sector sustainability.

The indicators selected and used by the stakeholders (with focus on the communities) should be easy to measure and understandable, reliable and cost effective.

The framework developed in this study for the monitoring of community sustainability, should be tested as a set, by applying it to monitor community's sustainability. The addition and subtraction of categories, variables and indicators can be made based on the requirement of the community.

For the monitoring of community sustainability, there is also the need to establish an organization or committee (comprising of all stakeholders) that will be responsible for planning, execution, monitoring and evaluation of community projects.

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APPENDICES

APPENDIX I

DEFINITIONS OF TERMS USED IN THIS REPORT

COMMUNITY

Lee *et al.* (1989) presented three definitions to define community in their book entitled "Introduction: Forestry, Community and Sociology of Natural Resources". According to the first definition "a community is a human settlement with a defined boundary". The second definition informs us that "a community is a local social system involving interrelationships among people living in the same geographical area". Finally, according to the third definition "community is a sense of shared identity".

CATEGORY

"A general class of ideas, terms or things that mark divisions or co-ordinations within a conceptual scheme" (Anonymous, 2005).

SUSTAINABLE COMMUNITY

"Sustainable community seeks to maintain and improve the economic, environmental, and social characteristics of an area so that its members can continue to lead healthy, productive, enjoyable lives" (Hart, 1995).

"A sustainable community is one that strives to maintain a healthy and thriving economy, society, and environment, adapts to external and internal stresses, takes advantage of internal and external opportunities, provides a high quality of life for residents, and persists through time" (Mackendrick and Parkins, 2004).

INDICATOR

"An indicator is something that points to a problem or condition. Its purpose is to show you how well a system is working. If there is a problem, an indicator can help you determine what direction to take to solve the problem" (Hart, 1995).

SOCIAL INDICATORS

"Social indicators are time series that allow comparison over an extended period and can be disaggregated by relevant characteristics; it also identifies long-term trends and measures periodic changes and fluctuations in the rate of change" (Rossi and Gilmartin, 1980).

According to Parkins and Beckley (2001), social indicators can be defined as "an integrated set of measures related to the social and economic well-being of human populations living within a forest ecosystem. Social indicators are statistics that can be collected over time and used for policy and management".

SUSTAINABLE COMMUNITY INDICATORS

"Sustainability indicators are selected key statistics or parameters that tracked over time, can present or summarize trends in social, economic, and environmental conditions" (Ditor *et al.*, 2001).

According to Hart (1995), "Indicators of sustainability are not the traditional indicators of economic success and environmental quality. Sustainability requires a more integrated view of the world. The indicators should link the economy, the environment, and the society in a community".

VARIABLE

"Likely to change or vary" (Anonymous, 2005).

APPENDIX II

Comparison of Sustainable Community Indicators developed under three different approaches in the CMFP (discussed in review of literature) to indicators developed in this study, entitled "Review and Synthesis of Sustainable Community Indicators used in Monitoring Forest Community Sustainability".

Criteria	Categories	Indicators	Project	Sector sustainability	Linkage across the sectors	Complete sustainability
Objective Indicators	Population and Migration	• Population • Age distribution by gender • Migration • Percentage change in migration	FMF	1	0	0
	Employment	• Unemployment rate • Change in female unemployment rate • Female participation in labor force • Male labor force activity • Male labor force participation • Participation in selected occupation by gender		1	0	0
	Human Capital	• Change in full time school attendance • Change in educational attainment • Highest level of education		1	0	0

0=No 1=Yes

Appendix II: (Continued)

	Income Distribution	• Income gap • Income distribution • Household income		1	0	0
	Poverty	• Measures of poverty • Incidence of low income by family and individual • Persons in low income family units		1	0	0
	Real Estate	• Average value of a dwelling • Average gross rent • Owner's major payments on housing • Household payments as a proportion of median income • Percent of owned and rented dwellings • Percent change in owned dwellings		1	0	0
Subjective Indicators	Community Perspectives on population and migration	• Community Perspectives on population and migration		1	0	0
	Jobs for the taking	• Jobs for the taking		1	0	0
	Service sector employment expansion	• Service sector employment expansion		1	0	0

Appendix II: (Continued)

Indicators	Seasons of employment	• Seasons of employment	PAMF	1	0	0
	Middle class employment	• Middle class employment		1	0	0
	Income and community cohesion	• Income and community cohesion		1	0	0
		• Restriction that minimizes water pollution		1	0	0
		• Peace and quiet		1	0	0
		• Fair and equitable property tax rates		1	0	0
		• Food, Health care and education available within the community		1	0	0
		• Public involvement in local decision making		1	0	0
		• Maintaining wildlife populations		1	0	0
		• Access to nature		1	0	0
		• Existence of wilderness in the local area		1	0	0
		• Enforcement of recreational regulations		1	0	0
		• A sense of belonging to the community		1	0	0
		• Employment in natural resources industries		1	0	0

Appendix II: (Continued)

Conservation of Biological Diversity	Ecosystem Diversity	• Forest composition and structure • Forests in protected Areas • Level of forest fragmentation, connectedness, and remoteness	LAMF	1	0	0
	Species Diversity	• Status of species at risk • Status of selected species		1	0	0
	Genetic Diversity	• Implementation of a genetic conservation strategy		1	0	0
Maintenance and Enhancement of Forest Ecosystem Condition and Productivity	Disturbance and Stress	• Level of disturbance in the LAMF • Levels of pollutants and chemicals usage on the forested land • Planned and actual depletions by type and forest Unit		1	0	0
	Processes and Functions	• Changes in forested area • Regeneration success • Silvicultural activities		1	0	0
	Ecosystem Productivity	• Tree growth and productivity • Quantity of forest products harvested vs. sustainable harvest levels (timber and non-timber)		1	0	0

Appendix II: (Continued)

Conservation of Soil and Water Resources	Biophysical Environment	• Soil chemistry and physical structures • Water quality • Hydrological conditions • Status of aquatic fauna		1	0	0
	Policy and Protection	• Soil and water protection		1	0	0
Forest Ecosystem Contribution to Global Ecological Cycles	Carbon Cycle	• Net primary productivity • Tree and non-tree biomass • Net carbon flux		1	0	0
	Energy Use	• Fossil fuel consumption in forest management • Processing efficiency		1	0	0
Multiple Benefits to Society	Timber	• Timber production		1	0	0
	Non-Timber Goods and Services	• Extractive goods and recreational/subsistence activities • Non-extractive forest-based recreation and tourism • Intangible goods and services		1	0	0
	Community Sustainability	• Population and employment profile • Family income profile		1	0	0

Appendix II: (Continued)

Accepting Society's Responsibility for Sustainable Development	Investment in the Forest Resource	• Investment in forest based research and development • Capital expenditures in forest resource-based businesses • Extent of aboriginal participation in and satisfaction with forest-based economics opportunities		1	0	0
	Public Participation and Decision-Making	• Public education and participation in decision-making • Aboriginal involvement in forest management planning and the extent to which planning respects aboriginal social, culture, and spiritual values/sites		1	0	0
	Criteria and Indicator Process	• Availability of information required for evaluation of criteria and indicators • Ongoing development and effectiveness of the criteria and indicators process		1	0	0

Appendix II: (Continued)

Employment	Present status of employment category	• Employment rate • Female participation in labor force • Male participation in labor force • Participation in selected occupation by gender	Results of this study	1	1	1
	Impact of employment on environment	• Is the increase in employment contributing to more waste creation? • Is the employment rate increasing or decreasing local dependency on forest resource? • Is there decrease or increase in legal fishing due to employment rate? • Number of parties caught doing illegal fishing? • Number of privately owned cars? • Effluent discharge to the river?		1	1	1
	Impact of employment on economy	• Number of new retail businesses established? • Number of locals and outsiders visiting the area for recreation? • Number of manufacturing units? • Value of real estate?		1	1	1

Appendix II: (Continued)

	Impact of employment on community	• Is there any community committee? • Number of decisions taken by the community committee for the recuperation of the bad indicators? • Level of decisions implementation? • Availability of loans on soft terms to community to initiate a business? • Number of skills development centers? • Kind of skills development • Community help center for poor? • Rehabilitation planning for poor people by the community committee? • Number of people visiting local hospital and walk-in clinics?		1	1	1

Appendix II: (Continued)

Education	Present status of the category	• Literacy rate • Change in full time school attendance • Change in educational attainment • Highest level of education • Number of colleges • operating in the area • Disciplines taught in the colleges		1	1	1
	Impact of education on environment	• Is community education contributing to reduction in waste creation? • Is there decrease in the local dependency on forests due to education? • Are people aware about the wise use of natural resources? • Is community education helping in the implementation of fishing plans?		1	1	1

Appendix II: (Continued)

		• Incidences of illegal fishing? • Use of automobiles growing or decreasing in the area? • Are people aware about the negative impacts of effluent discharge into stream systems? • Is there any decrease in illegal hunting? • Is there increase or increase in the number of wildlife?		1	1	1
	Impact of education on economy	• Increase in per capita income due to education • Is the retail business growing or decreasing due to community education? • Number of trained tourism guides in the area? • Is there any effort undertaken by the community to advertise tourism potential of the area?		1	1	1

Appendix II: (Continued)

		• Is the local manufacturing growing? • Are the educated people finding jobs in the manufacturing sectors? • Is community education contributing to the business in real estate?				
	Impact of education on community	• Presence of community committee in the area? • Number of meetings held monthly? • Attendance percentage by the committee members? • Number of decisions taken by the committee for the recuperation of the bad indicators? • Implementations level of the committee decisions? • Community recreation • Community health? • Formulation of natural resources conservation plans?		1	1	1

Appendix II: (Continued)

		• Monitoring level of the plans? • Measure taken to introduce eco-friendly behavior?				
Forest Operations	Present status of the category	• Number of timber companies operating in the area? • Types of machines used by the companies in forestry operations? • Silviculture system employed in the area for the management of the forest? • Implementation level of the management plans?		1	1	1
	Impact of forest operations on environment	• Type of waste created by forest operations? • Amount of Waste created during forest operations? • Is the waste created properly disposed off? • Impact of forest operations on erosion? • Reforestation of cut area?		1	1	1

Appendix II: (Continued)

		• Level of beating up operation? • Impact of forest operations on turbidity of streams? • Impact of stream turbidity on the population of major fish species found in the area? • Role of forest operations in changing the wildlife population of the area?		1	1	1
	Impact of forest operations on economy	• Jobs provided by the timber company? • Is the retail business growing or slowing down due to forest operations? • What impact do forest operations have on local tourism? • Type of manufacturing units in the area? • Is the manufacturing business growing due to forest operations?		1	1	1

Appendix II: (Continued)

		• Any role of forest operations in the value determination of real estate?				
	Impact of timber operations on community	• No of decisions taken by the community committee for the amelioration of the problem indicators? • Level of decisions implementation? • Steps taken by the community to diversify the economy? • Impact on community education? • Impact on community health? • Impact on community cohesion? • Level of community monitoring the forest operations?		1	1	1
Population	Present status of the category	• Total Population • Age distribution by gender • Migration		1	1	1

Appendix II: (Continued)

	Impact of population on environment	• Is the increase or decrease in population producing more waste? • Local dependency on forestry resource has increased or decreased? • Status of fishing due to increase in population? • Increase in the number of auto-mobiles due to increase in population • Status of effluent discharge into the water bodies? • Status of the quality of air? • Status of hunting?		1	1	1
	Impact of population on economy	• Increase or decrease in retail business due to the status of population? • Is there any impact of population on tourism? • Status of manufacturing business affected by the population growth? • Increase in population has any impact on real estate value?		1	1	1

Appendix II: (Continued)

	Impact of Population on community	• Steps taken by the community committee for the recuperation of the bad indicators? • Number of meetings held by the committee every month? • Implementation level of community decisions?		1	1	1

Sector sustainability 0= No 1=Yes. Across the sector sustainability 0=No 1=Yes. Complete sustainability 0=No 1=Yes